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ABSTRACT

Arguments for the inclusion of computers in the schools and guidelines for the effective use of computers in educational settings introduce this outline of a college course designed to train students and teachers to successfully utilize microcomputers in prekindergarten through third-grade classrooms. The argument is made that, since computers are being touted as a revolution in pedagogy, teachers must become knowledgable about the potential of computer technology. Only when equipped with such knowledge will teachers be able to assess proponents' claims and to lead in appropriately introducing computer technology into educational settings. Specifically, it is asserted that teachers must consider the context in which computer technology is introduced and the various potential uses of computers. In line with this recommendation, the course described, entitled "Teaching with Microcomputers: The Early Years," offers undergraduate and graduate students the opportunity to use the computer as a tutor, a tool, and a tutee. Tutored by the computer, they experience, evaluate, modify, and write instructional/managerial programs across early childhood subject matter domains. Using the computer as a tool, they learn about word processing and information management for themselves and children. Using the computer as tutee, they "teach the computer," learning to program and to teach young children to program in Logo. Finally, teachers are advised that others will take leadership in providing instruction with computers, if they do not. (RH)

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MICROCOMPUTERS IN EARLY EDUCATION: RATIONALE AND OUTLINE FOR TEACHER TRAINING

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Abstract

This paper provides teacher trainers who have varying levels of knowledge of microcomputer applications to education with a model for the justification and planning of a college course for teachers: Teaching with Microcomputers--The Early Years. It includes rationale/background, consideration of the educational context, alternative solutions and their consequences, and the need for critical evaluation. There is an increasing acceptance of the critical necessity for children to become computer literate and for teachers to become capable not only of teaching about computers, but of teaching with computers to improve the quality of education and meet contemporary educational objectives and problems. Early childhood educators need training in the use of the computer as an instrument for assisting and managing instruction, as a general purpose tool, as a prosthetic device for the handicapped and enrichment device for the gifted, and as a tool for teaching programming in a child-oriented computer language. Effective use of this tool demands consideration of the context of that use; training must take into consideration the content of the early childhood curriculum and the characteristics of the young child.
Promises made in the name of computer technology are numerous. Educators need to fulfill these promises whenever possible, yet guard against uncritical acceptance of these promises and the pedagogical implications drawn from them.

MICROCOMPUTERS IN EARLY EDUCATION: RATIONALE AND OUTLINE FOR TEACHER TRAINING

Background and Rationale for the Course

There is an increasing acceptance of the critical necessity for children to become computer literate. Over half the labor force holds information-related jobs; by 1985, over 75% of all occupations will deal with computers in some way (Molnar, 1981). Ignorance of computers will render people as functionally illiterate as ignorance of reading, writing, and arithmetic (Michaels, 1968). Therefore, educational organizations (National Council of Supervisors of Mathematics, 1978; National Council of Teachers of Mathematics, 1980) have advocated computer literacy for all children. Professionals have stressed the need for teaching computer literacy in the schools, citing it as the next great crisis in American education (Luehrmann, 1980; Molnar, 1981; Papert, 1980).

There are other arguments for the inclusion of computers in the schools. Teachers need to not only teach about computers, but teach with computers to improve the quality of education for children and meet the demands and problems of contemporary education. Research demonstrates that the computer can effectively manage and conduct instruction. However, the most powerful use of the computer is the least studied--the child's use of the computer as a tool. Many authorities have extolled the virtues of this approach. From word processing to programming, this use has the potential of expanding the intellectual capabilities of learners, making us all inventors of our own intellectual tools (Molnar, 1981; National Institute of Education, 1980; Olds, 1981); amplifying the powers of humanity and liberating human potential (Dwyer, 1980). However, it is just as important to note that these claims have <u>not</u> yet been substantiated. As has happened with so many innovations, computer use is being touted as a revolution in pedagogy. Education has a history of embracing a simplistic interpretation of such innovations and then, when practice reveals weaknesses, completely rejecting the theory. So that they will not blindly endorse nor needlessly reject computer technology, teachers need to be knowledgable of its potential and application.

<u>The educational context</u>. Effective use of any tool demands consideration of the context of that use. For teachers to effectively exploit the potential of the microcomputer, their training must take into consideration (a) the content of the curricula they are to teach, (b) the

psychological characteristics and capabilities of children in the grades they teach, and (c) their previous experience and orientation. With these considerations in mind, how might teachers of young children utilize these technological capabilities? The computer might serve both teachers and their students as a tutor, a tool, and a tutee (Taylor, 1980).

The computer as tutor. As a tutor, the computer is used by the teacher to supplement the presentation of curricular material. Computer programs (software) which are directly relevant to preschool and primary grade curricula must be experienced, evaluated, modified, and written by teachers responsible for teaching these grade levels. While introductory courses and experiences providing contact with general Computer Assisted Instruction (CAI) materials are necessary, teachers can not, and will not, use CAI materials in their classrooms unless they appreciate and master the use of software which specifically address their instructional needs. Such software exists; furthermore, research is beginning to accumulate supporting its efficacy in developing ability in readiness skills (including attention span), the language arts, reading, mathematics, science, and social studies (e.g., Brebner, Hallworth, McIntosh, & Wontner, 1980; Cleary, Mayes, & Packham, 1976; Fletcher, 1976; Howe & O'Shea, 1979; Hungate, 1982; Kimmel, 1981; Lewis, 1981; Staples, 1981; Swigger, 1982; Swigger & Cambell, 1981; Tekawa, 1980). Teachers and students need resource material, guidebooks, project suggestions, and so on. The more specific the goals, the more detailed and extensive the materials needed (Watt, 1982); also, the more grade-level appropriate materials need be.

The appropriateness of CAI must also be addressed. Computers can be programmed so that, for example, three-dimensional representations of blocks appear on the screen to be counted. While this is interactive, and feedback is given, it may be that the traditional provision of real, movable objects constitutes a more complete and educationally meaningful experience for children whose logico-mathematical learning depends heavily on action sequences (Piaget, 1952). The essential question is: What experiences should and should not be computerized for young children (Thomas, 1981)?

Teachers can learn to use authoring languages (computer languages specifically designed to help teachers write CAI materials) such as PILOT (Programmed Inquiry, Learning Or Teaching). Within a few hours, even inexperienced teachers can begin to write short instructional programs (Camuse, 1982; see descriptions of other systems in Lubar, 1981, and

guidelines to the design of programs in Hartman, 1982; Thomas, 1981).

Training in the use of Computer Managed Instruction (CMI) must also be relevant to teachers. The programs studied must be usable by young children and must meet the needs of teachers for flexible grouping. Research comparing classrooms with CMI and those without it has usually favored the former, both in terms of students' achievement and attitude toward the subject. There is some evidence that children react favorably to the CMI systems themselves, as have parents. Computer assisted testing has been shown to be a better predictor of success in mathematics than standardized testing, and students considered it more fair (Brebner, Hallworth, McIntosh, & Wontner, 1980; Cartwright & Dervensky, 1976; Haugo, 1981; Kieren,1973; McIsaac & Baker, 1981; Spuck & Bozeman, 1978). It is not certain if all these results apply to early education. Consideration of personal and psychological parameters will reduce the likelihood of failure that threatens so many technological applications (Bozeman, 1978).

The computer as a tool. As a tool, the computer will be an invaluable aid in helping the teacher of young children meet the needs of young handicapped children (prosthetic devices, individualize and monitor instruction, motivate, manage IEP's, etc.; Cleary et al., 1976; Papert & Weir, 1978. Significantly, research indicates that special needs children are motivated by computer-based instruction; Cartwright & Derevensky, 1976). Managing information through computer technology has rescued preschool programs which must gather data on student background, health services, evaluations, handicap services, food services, attendance, social services, and parent participation (Cogdill & Goldberg, as cited in Joiner, Vensel, Ross, & Silverstein, 1982). Again, it can be noted that application of computer technology must consider the needs of the teacher and his or her students.

Students can also use the computer as a tool. Goals of computer literacy, reading and writing abilities (as well as all curricular areas), and study/organization skills will be developed as children use the computer to help the teacher keep records such as attendance, make graphs, compose music, and create computer art. Yet these goals will be achieved only if teachers are skilled in the use of software which is appropriate for interactive use by young children. This need is nowhere more important than in the last category of computer use, the computer as a tutee.

The computer as tutee. As a teacher, the computer

represents a powerful tool; yet its real impact will be on children who teach the computer. By programming the computer to do what they want it to do, children must reflect on how one might do the task oneself. "In teaching the computer how to think, children embark on an exploration about how they themselves think" (Papert, 1980). Computers will serve as intellectual amplifiers. Marvin Minsky of MIT has said: "Eventually, programming itself will become more important even than mathematics in early education" (Minsky, cited in Milner, 1980). It is essential, however, to once again consider the characteristics of the young child. BASIC is an excellent computer language for older children. However, it was initially written for college students. There are alternate languages, like Logo, that are appropriate for young children in that they are high-level, interactive, "natural" (English language oriented), "user-friendly," and procedural. This means that children can build their own commands, program in units of words and sentences, write meaningful programs within minutes of sitting down in front of the computer, and "debug" their programs and their own thinking. Logo is a language for learning. That in fact young children can learn to, and learn from, programming in Logo has been substantiated in at least pilot work (Howe & O'Shea, 1979; Papert, 1980; Papert, diSessa, Watt, & Weir, 1979). It appears possible to integrate this into the school day; however, to do this, teacher training is critical (Watt, 1982).

Here again, however, quality teacher training is also necessary to guard against uncritical acceptance of ideas and promises such as these. A leading exponent of the use of computer programming to expand children's intellectual power, Seymour Papert (1980), based his ideas on the theories of Piaget, with whom he studied. However, Papert has not addressed certain Piagetian hypotheses which would tend to argue against the notion of the revolutionary potential of the computer. For example, that no environmental conditions can allow young children to deal with abstract concepts before they reach the period of Formal Operations. Similarly, the claim that computer programming will restructure the way children think is not supported by the Piagetian notion that thinking progresses according to fixed biological laws, in conjunction with, but never determined by interactions with the environment Rousseau & Smith, 1981). Also ignored are some lessons from history, notably the Progressive Education Movement, which demonstrated that children in complete control of their own learning may limit themselves to a relatively narrow range of interests. Lastly, for very young children, several questions must be addressed: What is the effect of computer use on their development? Are other, possibly more

valuable, experiences supplanted? Such issues and controversies must be studied and discussed if teachers are to use computer technology wisely.

Many have advocated that all teachers "be required to take a course in computer programming" (Milner, 1980, p. 546). BASIC may be an appropriate language for teachers of older children. However, languages such as Logo provide a problem-solving environment which permits young children to play with powerful ideas. They provide a natural, humanistic approach which matches the orientation of most early childhood educators. Therefore, they are much more appropriate languages for teachers of young children to learn. Once again this argues for teacher training which is specific to the grade level and needs of the teacher.

Summary. Not only do we need computer literate teachers to produce computer literate children; but teachers who are not computer literate are not fully prepared to help children develop in any of the many areas of concern in education. They cannot effectively use these technological tools to help children learn subject matter content, interact socially, and further their intellectual development. Teachers will have computing resources at their disposal (Beck, 1980); they need to know how best to use them. To learn this requires that they receive continued support and training (Watt, 1982). "The failure of schools to make a major commitment to computer literacy now can have disastrous consequences for the public and for public education" (Watt, 1981, p. 87).

Thus if we do not produce teachers capable of using this tool, we do an injustice to those teachers as professionals and ultimately to children.

Alternative Solutions and Their Consequences

Computers are proliferating in business, industry, and the home. If colleges of education do not take responsibility for leadership in computer education, others will. If this happens, computer education will be in the hands of those without dedication to, and expertise in, the provision of educational opportunities befitting a democracy. The first ramification is the possibility of a decrease in the quality of education for every child. The second is the possibility of a societal movement toward overreliance and submission to the "expert" (either computer or technocrat), what Hansgen (1982) has termed "the tyranny of expertise."

It might be thought that microcomputer sales people

could provide this training. This presents several disadvantages. They are not well versed in educational theory, practice, or software--they are inclined not to dispel the myth that educators can purchase a computer and "someone" can write programs for it. They tend not to emphasize possible complications. They are not particularly able to ally the apprehensions teachers have, dispelling the mystique of the computer. This is a necessary first step. Without a teacher educator with a knowledge of microcomputers and software, computers in the schools will fall into disuse or misuse.

Finally, as the preceding section has emphasized, courses must take into consideration the characteristics of the teachers and the students they will teach. Thus, they must be tailor-made to meet the needs of both. No "umbrella" course for all education majors can meet these needs. However, both undergraduate and graduate students have these needs. Few early childhood education majors have expertise in this area; even those who have had some contact with computers are relatively inexperienced in early childhood applications. Therefore, undergraduate and/or graduate courses can be recommended.

Objectives

Teachers will:

1. experience, evaluate, and modify instructional programs dealing with early childhood curriculum.

2. demonstrate competence in using "tool" programs such as word processing and classroom and information management; apply such programs in professional and managerial work and in helping children use these tools.

3. demonstrate competence in programming in Logo and in developing instructional approaches for teaching this language to young children.

4. develop plans for implementing a computer literacy program for young children.

5. develop plans for organizing computer use in the classroom, including the computer as a tutor, tool, and tutee for teacher and for child.

6. design instructional units for the curricular areas of early childhood education which incorporate computers.

7. describe the dangers and disadvantages of computers.

8. describe the use of microcomputers in instructing the special child.

9. design and construct a specific-application lesson in PILOT.

Course Abstract

The course is designed to train students to successfully utilize microcomputers in prekindergarten to grade 3 classrooms. Students will integrate course content with direct laboratory experience with microcomputer applications. The course design considers the characteristics of early childhood educators and young children. Students will learn to use the computer as a tutor, a tool, and a tutee. In its role as a tutor, they will experience, evaluate, modify and write instructional/managerial programs across early childhood subject matter domains. As a tool, they will experience the power of word processing and information management for themselves and children. As a tutee, they will "teach the computer"--learning to program and teach young children programming in Logo. This language for learning has powerful graphic and language arts capabilities, and the potential of expanding the intellectual capabilities of young learners. Special topics will include computer literacy for young children, dangers in the computer world, and microcomputers and the special child.

Course Outline

I. Why have computers in the preschool and primary school?
   A. The current place of the computer in the young child's world.
   B. For instruction: an introduction.
      1. Teaching about computers: computer literacy.
      2. Teaching how to use computers: computers as tools--e.g., Logo
      3. Teaching with computers: computers as tools for the teacher.
   C. Teaching special groups: the handicapped and gifted.

II. What is going on with computers in preschool and primary grades?
   A. Computer-Assisted Instruction (CAI): Some examples for the young child
      1. Drill and practice
      2. Tutorial
      3. Simulation
      4. Instructional games

5. Problem solving
6. Information retrieval; DBMS

B. Computer-Managed Instruction (CMI)
1. Testing, diagnosis, and prescription.
2. Progress tracking.

C. Other uses.
1. Record Keeping.
2. Word processing (by the teacher).
3. Developing original instructional materials.

III. Computer literacy: What should young children know about computers?

IV. What about programming?
A. Do I have to know programming? (reducing anxiety).
B. What do I do if I want to learn and teach programming?
1. Lessons with Logo.
2. Creative computing: Ideas on stimulating creative use of the computer in the classroom.
3. Fostering cognitive development.
C. Writing educational software: Lessons in PILOT.

V. How can computers help in teaching specific subjects?
A. The language arts.
1. Word processing: Its use in composition and reading.
2. Programs to teach specific knowledge.
3. Teaching the computer to compose.
B. Science and social studies.
1. Simulations.
2. Inquiry: Solving problems utilizing the computer as a tool.
D. Mathematics
1. Inquiry: Logo and the exploring child.
2. Instructional programs.
E. The Arts

VI. Are There Dangers in the Computer World?
A. Authoritarianism, experts, and the computer.
B. The "addiction" of video games and the (positive) addiction to learning.
C. Automation: How will it change our world; will it change us?
D. What are the effects of microcomputer use on very young children? Are other important activities supplanted?

Course Evaluation

1. Topical outline tests--both written and performance criteria

2. Resource file of units and activities

3. Computer programs as developed by the students

4. Class participation--discussions and laboratory

Course Hardware and Software

Obviously, availability of funds limit purchasing. A moderately satisfactory solution would be the acquisition of enough microcomputers for half of the class. If this is not possible, three or four might be used for demonstration and then be available during the week for student laboratory use. Some college classes have been conducted in local microcomputer stores. If the curriculum does call for programming in Logo, make sure that this language is available for the microcomputers you will use. Several sources which present a guide to hardware selection are available (Braun, 1979; Thomas & McClain, 1979; Thorne, 1980).

Similarly, acquiring software can be an expensive proposition. Logo may be your first purchase. You can then choose from authoring languages (e.g., PILOT) or utility programs for word processing, filing, graphing, and the like. If you have the funding to purchase CAI and CMI materials, your time will be wisely spent in the study software reviews and evaluation guides (see the computing magazines in local computer stores and Douglas & Neights, n.d.; Dyer & Forcier, 1982; Heck, Johnson, & Kansky, 1981; Holznagel, 1981; Jaycox, 1979; MicroSIFT, 1981). Reviews can serve as substitutes for materials not purchased.

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